

Work in Progress - An Innovation Merging “Classroom Flip” and Team-Based Learning

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Abstract – This work in progress compares two versions of a “classroom flip” instructional strategy in which lectures are moved from inside class to outside class. Class time is then spent on problem solving and feedback. In previous offerings of this materials science course, students were asked to read instructor-supplied lecture notes and complete an on-line warmup assignment prior to class. Informal cooperative learning activities such as think-pair-share were used during class, and clickers provided a mechanism for probing understanding and providing feedback. In the most recent offering, students viewed instructor-prepared multimedia microlectures and took an individual quiz as homework, then repeated the quiz and completed a problem set with an assigned team during class. Thus, the redesigned course delivered multimedia rather than text lectures, and utilized a structured team-based learning strategy rather than informal cooperative learning structures. Moreover, higher level “material selection challenges” were added to the redesigned course. This paper summarizes the planned assessment and evaluation methods to compare the two classroom flip models; results and analysis are not yet complete.

Index Terms – Active learning, classroom flip, blended learning.

INTRODUCTION

Content-crammed courses have been a perennial barrier to the widespread adoption of pedagogies of engagement in engineering education. Numerous movements in the last decade have demonstrated that use of active learning methods can enhance student learning outcomes without sacrificing coverage of content [1,2]. Models such as “Just-in-Time-Teaching” [3] and Team-Based Learning [4] offer ways to transfer learning of foundational knowledge into outside-of-class activity, freeing up class time for higher-level application and problem-solving. This strategy is also at the heart of the “classroom flip” and “inverted classroom” models that have been introduced at FIE and ASEE conferences recently (e.g., [5-6]). In these courses students are asked to use out-of-class time to view pre-recorded multimedia lectures, so that class time can be used to provide practice, guidance, and feedback in problem-solving. This paper describes a course redesign and evaluation for a large enrollment (N~125) introductory materials science and engineering course in a way that builds

upon, integrates, and extends the team-based learning and classroom flip models in an increasingly blended learning environment.

CLASSROOM FLIP VERSION 1

I have been using active learning pedagogies for more than a decade in this large enrollment introductory materials science course. In recent years, prior to each class students were asked to review instructor-provided lecture notes, augment that with textbook reading, and complete a “warm-up” assignment consisting of two Blackboard-deployed, open-ended questions. Class time was used for informal “think-pair-share” problem-solving and feedback, facilitated by the individual use of “clickers.” I was using a course structure that is now being called a “classroom flip,” except that students were asked to *read* lecture notes instead of *view* multimedia lectures as homework.

While this course was successful from both student and instructor perspectives, I still saw room for improvement in several areas. First, I wanted to further enhance engagement during class. Peer-assisted learning was underutilized since a fair number of students (perhaps 10-15%) chose not to participate in “think-pair-share” and “turn-to-your neighbor” activities. I also noticed when circulating around class that a similar fraction of students would not be working actively on problems. Second, I wanted to increase student “time on task” in the course. Although class attendance started off strong, it declined as the term progressed. In addition, student reports of time on task (hours per week spent on all course activities) were, on average, below the university’s stated expectations. Finally and perhaps most importantly, after reading a book on course design [7], I was inspired to modify the course goals to include more higher level thinking and explicit attention to development of lifelong learning skills.

CLASSROOM FLIP VERSION 2

Table I summarizes the goals for the course redesign and strategies used to achieve them, and Figure 1 shows a visual representation of the daily sequence of activities. In the redesigned course, the text-based lecture notes were replaced by pre-recorded multimedia “microlectures,” 10-15 minutes in length and tightly focused on a specific instructional objective. Two to three microlectures were typically assigned for each class. Students took a 5-question Individual Readiness Assessment Test (IRAT) on this foundational knowledge before class. In addition, a more

structured team-based learning strategy was used [4], with students assigned to work in teams of four during class. At the start of class, teams compared their responses to the IRAT and agreed upon team responses (Team Readiness Assessment Test). The instructor then reviewed common misconceptions and summarized key concepts. Teams then completed a Team Problem Set with higher level application problems, and in some cases more complex “Material Selection Challenges.” During class time, the instructor circulated to provide assistance, provided whole-class clarification when needed, and occasionally launched clicker questions to see how teams were thinking about questions on the problem set and provide feedback.

TABLE I
GOALS AND INSTRUCTIONAL STRATEGIES FOR CLASSROOM FLIP VERSION 2

Goals for Redesign	Teaching Strategies
Increase student engagement and learning during class periods	Used structured team-based learning rather than informal cooperative learning pairs.
Increase time on task in the course as a whole.	Replaced participation-based grading of preparation quizzes and in-class work with criterion-based (mastery) grading. Attempted to make outside-of-class lectures more engaging and effective by replacing text with multimedia and including worked examples of simple problems
Expand course goals to include material selection decisions and material failure mechanisms	Four whole-class-period “Material Selection / Material Failure Challenge Problems”
Include lifelong learning as an explicit course goal.	Emphasized significant responsibility for self-led learning outside of class and team-based learning inside of class. Deployed periodic “Knowledge Survey” self-assessments. Peer evaluations affected course grade.

METHODS

The following measures will be used to provide both breadth and depth of insight into the student and instructor experience in the redesigned course:

- Self-reported “time on task” in the previous course and the redesigned course;

- Usage tracking statistics for online text-based lecture notes versus streaming microlectures;
- Class attendance statistics in the two course formats;
- Grade distributions and exam grades in the two courses;
- A comparison of content and learning objectives in the two courses;
- Student responses to questions on end-of-course evaluations related to engagement;
- Student comments and reflections on the use of the microlectures, classroom flip, and team-based learning in the redesigned course; and
- Instructor reflections from a teaching journal.

EXPECTED OUTCOMES

Even triangulation of multiple assessment measures will not allow any claims about the comparative learning outcomes in these two courses in a way that would be generalizable. Furthermore, since multiple variables were different between these two courses, it will be impossible to infer which changes were most or least influential. Still, this innovation and its assessment are expected to shed light on both the opportunities and challenges of converging active learning pedagogies with blended learning environments.

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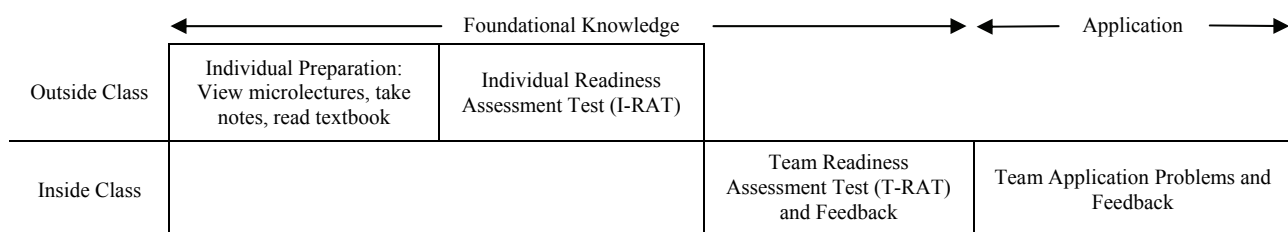


FIGURE 1
COURSE STRUCTURE AND DAILY SEQUENCE OF ACTIVITIES IN CLASSROOM FLIP VERSION 2